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Division of Wildlife Resources - Native Aquatic Species

LEAST CHUB
(Iotichthys phlegethontis)

MONITORING SUMMARY

Gandy Marsh and Bishop Springs
2005

Publication Number 05-32
Utah Division of Wildlife Resources
1594 W. North Temple
Salt Lake City, Utah
James F. Karpowitz, Director

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INTRODUCTION

Least chub (*Iotichthys phlegethontis*) historically occupied a variety of habitats including rivers, clear streams, springs, ponds, and marshes (Sigler and Miller 1963). However, all known populations are currently restricted to isolated springs and associated marshes. Least chub habitat typically consists of small springs or ponds with cool stable temperatures, relatively low, stable dissolved oxygen values, and low conductivities (Perkins et al. 1998). Least chub are typically found in habitats consisting of moderate to dense emergent, floating, and submergent vegetation. Wetland vegetation most commonly associated with least chub habitat include: olney threesquare (*Scirpus americanus*), common threesquare (*S. pungens*), softstem bulrush (*S. validus*), wiregrass (*Juncus balticus*), clustered field sedge (*Carex praegracilis*), common cattail (*Typha domingensis*), common spikerush (*Eleocharis palustris*), duckweed (*Lemna sp.*), cutleaf water parsnip (*Berula erecta*), and waterfern (*Azolla mexicana*).

Least chub, which are endemic to the Bonneville Basin of Utah, have been declining since the 1940s (Holden et al. 1974), and studies over the last 20 years indicate a continued decline in their distribution and abundance (Perkins et al. 1998). Collections within the Bonneville Basin indicate that the approximate range of least chub once included Big Cottonwood Creek, the Provo River, Utah Lake, Beaver River, Parowan Creek, and Snake Valley (Sigler and Miller 1963, Crist 1990). However, Workman et al. (1979) surveyed historically occupied areas in Millard, Juab, Weber, Salt Lake, and Tooele counties, and concluded that least chub had been extirpated from a majority of their original range. Specifically, Workman and his colleagues showed that least chub distribution is limited to areas within Snake Valley, including the Gandy Marsh complex, Leland Harris Spring complex, Callao Spring complex, Twin Springs (Bishop Springs), and Redden Springs. Surveys

conducted by Utah Division of Wildlife Resources in the mid 1990s found two previously unknown populations of least chub in Juab County: one in the Sevier River drainage within Mills Valley, and another near the town of Mona in Juab Valley (Perkins et al. 1998). Further surveys in 2003 led to the discovery of another previously unknown population of least chub at Clear Lake Waterfowl Management Area in Millard County (Fridell et al. 2003a).

The first recorded collection of least chub in Snake Valley was by C. L. Hubbs in 1942 at the Gandy Marsh complex in Millard County (Sigler and Miller 1963). In 1970, R. R. Miller collected least chub from the Leland Harris spring complex in Juab County (Sigler and Sigler 1996). These findings prompted the West Desert survey conducted by Workman et al. (1979), which revealed the distribution of least chub was limited to Snake Valley. Osmundson (1985) found that least chub were most abundant in the Gandy Marsh and Leland Harris spring complexes within Snake Valley. He noted that least chub were least abundant in Miller Springs (near Leland Harris) and Bishop Springs (Twin and Central Springs). Further research has indicated that least chub have been extirpated from the Callao and Redden Spring complexes (Crist 1990). Thus, within Snake Valley, least chub are currently limited to Leland Harris, Gandy Marsh, and Bishop Springs (Perkins et al. 1998, Fridell et al. 2003b, Wheeler et al. 2004).

Due to declining distribution and abundance, least chub are currently classified as a conservation species by the State of Utah (Perkins et al. 1998). In 1998, the Conservation Agreement and Strategy for Least Chub (*Iotichthys phlegethontis*) in the State of Utah (Perkins et al. 1998) was developed in an effort to expand least chub populations and enhance their habitat. Conservation actions identified in the Conservation Agreement include: wetland re-vegetation, water quality improvements, construction of grazing exclosures, surveys of suitable least chub habitat,

control of nonnative species, genetic analysis, and monitoring of least chub populations. Long-term population monitoring is necessary to track least chub trends and their response to implementation of conservation actions.

In August 2005, the Utah Division of Wildlife Resources conducted the thirteenth consecutive year of least chub monitoring in Snake Valley, Utah. The objective of this ongoing effort is to monitor least chub populations and their habitat trends in Snake Valley within the West Desert Geographic Management Unit (Perkins et al. 1998). Although surveys from Leland Harris were previously included in this Snake Valley monitoring report, Leland Harris was monitored separately this year and will not be discussed in this report. Future least chub monitoring at the Leland Harris will be conducted and summarized by the Central Region of the Utah Division of Wildlife Resources. The areas sampled and methodology used in Gandy Marsh and Bishop Springs is consistent with monitoring conducted in previous years (Fridell et al. 1999, Fridell and Marr 2000, Fridell and Malecki 2001, Fridell et al. 2002, Fridell et al. 2003b, Wheeler et al. 2004).

METHODS

In Snake Valley, least chub were sampled at Gandy Marsh and Bishop Springs complexes (Figures 1 and 2). A total of 65 sites were visited within these complexes (Gandy = 52, Bishop Springs = 13). Each of the 65 sites has been designated as an annual monitoring site and has been individually marked with permanent stakes. To determine the presence/absence of least chub, a minimum of one wire minnow trap (44.5 cm long, 22.9 cm diameter, 0.66 cm mesh) was placed at each site where water depth was sufficient to submerge the trap openings. All traps were set at a minimum depth of 13 cm (5") and were left for two to four hours before being removed. Trap locations, trap depths, and total trapping times were recorded at each site. All captured fish were

positively identified and respective lengths were measured and recorded. Least chub size distribution was examined for each spring complex by plotting length frequency histograms in millimeter increments. In addition, mean length for least chub was calculated for each spring complex.

Habitat inventories were conducted at all springs to assess physical parameters of the site and to determine species occurrence and abundance of aquatic flora. Pool size, maximum water depth, substrate depth, bank condition, livestock damage, and similar habitat indices were recorded on standardized data sheets. Limited water quality parameters, including pH, dissolved oxygen, and temperatures were also recorded at each location.

RESULTS

From August 22 to 25, 2005, field crews surveyed 65 pre-established sites within the Gandy Marsh and Bishop Springs complexes. Least chub comprised 50.0% (least chub = 251; Utah chub = 199; speckled dace = 52) of all fish captured at the two areas (Tables 1 and 2). Of the 65 sites sampled, least chub were captured in 22 (33.8%), Utah chub (*Gila atraria*) occurred in 13 (20.0%), and speckled dace (*Rhinichthys osculus*) were found in 14 (21.5%) sites (Tables 3, 4, and 5). A brief synopsis of monitoring results for the Gandy Marsh and Bishop Spring complexes follows.

Gandy Marsh (Sample # 05-013 - 05-064)

Least chub were captured in 12 of 52 (23.1%) sites sampled at Gandy Marsh (Table 3). Species present in this complex included least chub, Utah chub, and speckled dace (Table 6). Least chub comprised 60.5% (least chub = 173; Utah chub = 70; speckled dace = 43) of all fish captured (Table 1). Livestock damage was concentrated at sites outside of exclosures and was mostly low except for a few moderate sites. Among sites containing least chub, average water depth ranged

from less than 0.1 m to 3.5 m and surface water temperatures ranged from 14.4° to 24.0° C (avg = 18.2° C). Dissolved oxygen ranged from 0.30 to 10.04 mg/L (avg = 4.51 mg/L), and pH ranged from 7.5 to 8.7 (avg = 8.1). Substrate of the majority of sites in the Gandy Marsh complex was organic with a few sites containing silt substrates. Water in Gandy Marsh was mostly confined to spring heads.

Length frequency distributions of least chub at Gandy Marsh (Figure 3) show that the majority of fish collected were between 36 and 53 mm in length. Mean length of least chub captured at Gandy Marsh was 42.7 ± 4.2 mm.

Bishop Springs (Sample # 05-065 - 05-077)

Least chub were captured in 10 of 13 (76.9%) sites sampled at Bishop Springs (Table 3). Species present in this complex included least chub, Utah chub, and speckled dace (Table 7). Least chub comprised 36.1% (least chub = 78; Utah chub = 129; speckled dace = 9) of all trapped fish (Table 2). Black spot cysts appeared on many fish (n = 83) of all species captured, however it was concentrated in the Twin Springs outflows and Central Springs areas. Ungulate damage was low at all sites; however, at Twin Springs South, livestock have severely impacted banks, resulting in shallower water and increased surface area and sedimentation of the spring. Among sites containing least chub, average water depth ranged from 0.1 m to >2.0 m, with surface water temperatures ranging from 15.5° to 24.5°C (avg = 20.53°C). Dissolved oxygen ranged from 2.34 to 11.12 mg/L (avg = 6.87 mg/L), and pH ranged from 7.8 to 8.5 (avg = 8.02). Organic material and clay constituted the major substrates at all Bishop Springs sites.

Least chub length frequency distributions for Bishop Springs show that most fish collected were between 36 and 53 mm in length (Figure 4). Mean length of least chub captured at Bishop

Springs was 42.4 ± 3.5 mm. Water levels at Bishop were high enough to trap at all sites. In many previous years the lower parts of Bishop Springs dried due to dewatering at Foote Reservoir.

SUMMARY

Gandy Marsh

- Least chub were trapped in 12 of 52 (23.1 %) of the springs at Gandy Marsh (Table 3). This is the highest total of sites containing least chub recorded since 2000 (Figure 5).
- Livestock damage has been controlled by the construction of exclosures, and has been confined to limited areas outside the exclosures.
- Least chub have been captured in a total of 30 different springs since 1993 (Table 6).

Bishop Springs

- Least chub were trapped in 10 of 13 (76.9%) of the sites at Bishop Springs (Table 2). This is higher than any year since 1993 (Figure 6).
- Although water levels were higher in 2004 than previous years, dewatering at Foote Reservoir continues to reduce habitat and threaten the long-term viability of least chub at Bishop Springs.

Table 1. Species and number of fish captured by spring (n = 52) in the Gandy Marsh complex, Snake Valley, Utah from 1999 to 2005.

Spring No.	1999	2000	2001	2002	2003	2004	2005
1	-	-	-	-	Water Depth < 5cm	-	-
2	-	-	-	-	-	-	-
3	-	-	-	-	Water Depth < 5cm	-	-
4	SD = 1	-	-	-	-	-	-
5	LC = 19	LC = 9, SD = 1	LC = 22, SD = 4	LC = 3, SD = 8	-	SD=1	UC=1
6	LC = 1	LC = 7, SD = 2	-	LC = 5, SD = 2	-	-	-
7	Water Depth < 5cm	Water Depth < 5cm	Water Depth < 5cm	Water Depth < 5cm	-	-	-
8	LC = 11	LC = 33	LC = 115, SD = 13	LC = 240, SD = 29	LC = 1, SD = 1	LC=58, SD=3	LC=33
9	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-
11	-	-	-	Water Depth < 5cm	-	-	-
12	-	LC = 1	-	Water Depth < 5cm	Water Depth < 5cm	-	-
13	-	-	-	-	-	-	-
14	LC = 164, UC = 1	LC = 25, UC = 4	LC = 51, UC = 2	LC = 41, SD = 13	-	SD=1	-
15	LC = 3	-	Water Depth < 5cm	Water Depth < 5cm	-	-	-
16	LC = 1, UC = 1	LC = 1	LC = 4, UC = 7	-	LC = 13, UC = 15	LC=7, UC=38, SD=2	LC=8, UC=35, SD=6
17	LC = 13	LC = 21	LC = 72, UC = 2, SD = 1	LC = 12, UC = 19, SD = 1	LC = 8, UC = 35, SD = 2	LC=5, UC=2, SD=3	LC=3, SD=3
18	-	Water Depth < 5cm	-	Water Depth < 5cm	-	-	LC=1
19	-	-	-	Water Depth < 5cm	-	-	-
20	LC = 5	LC = 4, UC = 2	LC = 14	LC = 7, UC = 13	LC = 11, UC = 1	-	LC=10, UC=1
21	-	-	-	-	-	-	-
22	-	-	-	Water Depth < 5cm	-	-	-
23	-	-	-	-	-	-	-
24	-	-	-	Water Depth < 5cm	-	-	Water Depth < 5cm

Table 1. (continued)

Spring No.	1999	2000	2001	2002	2003	2004	2005
25	Water Depth < 5cm	-	Water Depth < 5cm	Water Depth < 5cm	-	-	Water Depth < 5cm
26	LC = 2, UC = 4, SD = 1	SD = 1	UC = 1	UC = 2	-	-	-
27	-	-	-	-	-	-	Water Depth < 5cm
28	LC = 335	LC = 56, SD = 8	LC = 16, SD = 8	LC = 50, SD = 23	LC = 2, UC = 6	LC=2, SD=2	LC=33, SD=33
29-37	LC = 18	LC = 40, SD = 5	-	SD = 1	-	SD=4	-
38	LC = 134	LC = 219	LC = 378, SD = 273	LC = 112, SD = 18	LC = 100, SD = 2	LC=1	LC=10
39	SD = 1	LC = 9, SD = 3	LC = 54, SD = 273	LC = 7, SD = 7	-	LC=1, UC=4	LC=1, SD=21
40	-	SD = 1	SD = 4	-	SD = 2	-	SD=1
41	-	-	-	-	-	-	-
42	-	-	-	-	LC = 1	LC=2	-
43	-	-	-	-	-	-	-
44	LC = 5, UC = 2	LC = 117	LC = 5	LC = 29, UC = 4	-	LC=36, UC=1, SD=2	LC=66, SD=6
45	-	SD = 1	-	-	-	-	SD=2
46	LC = 21	LC = 29	LC = 24	-	-	-	SD=1
47	-	-	-	-	-	SD=1	-
48	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-
50	-	Water Depth < 5cm	Water Depth < 5cm	Water Depth < 5cm	Water Depth < 5cm	-	Water Depth < 5cm
51	-	-	-	-	-	-	-
52	-	Water Depth < 5cm	-	-	-	-	LC=2
53	-	LC = 12, SD = 16	Water Depth < 5cm	LC = 13, SD = 5	LC = 1	LC=8, SD=5	SD=3
54	-	UC = 16, SD = 1	-	-	-	-	-
55	-	UC = 2	-	-	-	-	LC=1
56	-	-	-	-	-	-	-
57	LC = 1	Water Depth < 5cm	Water Depth < 5cm	Water Depth < 5cm	-	-	LC=5

Table 1. (continued)

Spring No.	1999	2000	2001	2002	2003	2004	2005
58	-	-	-	-	-	-	-
59	Not Sampled	-	-	-	-	-	-
60	-	-	-	-	-	-	-
Total	LC = 732, UC = 8, SD = 3	LC = 583, UC = 24, SD = 39	LC = 755, UC = 12, SD = 30	LC = 519, UC = 38, SD = 107	LC = 137, UC = 51, SD = 13	LC=120, UC=41, SD=28	LC=173, UC=20, SD=43

Fish trapped: LC = least chub, UC = Utah chub, SD = speckled dace

Table 2. Species and number of fish captured by spring (n = 13) in Bishop Springs , Snake Valley, Utah from 1999 to 2005.

Spring No.	1999	2000	2001	2002	2003	2004	2005
South Twin	-	‡	UC = 1	UC = 1, †	LC = 2, UC = 18, †	UC=4	LC=11, UC=11, SD=1
North Twin	-	UC = 7	UC = 30	UC = 8	UC = 45	LC=1, UC=51	-
1	*	*	-	LC = 5, UC = 3, SD = 1	*	LC=3, UC=14	LC=30, UC=56
2	*	*	LC = 4	LC = 2, UC = 2	*	-	LC=5
3	LC = 4	LC = 8, UC = 5	LC = 1, UC = 3	LC = 3, UC = 11	*	LC=5, UC=1	LC=2, UC=2
4	-	LC = 12, UC = 12	LC = 8, UC = 62	LC = 15, UC = 46	*	LC=6, UC=29	LC=7, UC=3, SD=1
5	LC = 11, UC = 21, SD = 1	LC = 7, UC = 14, SD = 1	UC = 19	LC = 4, UC = 19	*	UC=2	UC=2, SD=1
6	LC = 4	LC = 6, UC = 1	LC = 7, UC = 5, SD = 3	LC = 4, UC = 2, SD = 3	LC = 7, UC = 7, SD = 4	UC=2	LC=1
7	LC = 5, UC = 91	LC = 6, UC = 22	LC = 9, UC = 60, SD = 1	LC = 4, UC = 38, †	LC = 12, UC = 167	LC=2, UC=5	LC=2, UC=2
8	LC = 2, UC = 16	LC = 6, UC = 38, SD = 1	LC = 1, UC = 4, SD = 1	LC = 13, UC = 17	UC = 12, SD = 3	LC=1, UC=14, SD=2	LC=12, UC=24, SD=5
9	LC = 7, UC = 13	LC = 1, UC = 39	UC = 15, SD = 1	-	LC = 1, UC = 30	UC=51	LC=3, UC=27, SD=1
10	UC = 17, SD = 3	UC = 52	LC = 6, UC = 41	UC = 16	UC = 22, SD = 4	SD=2	UC=2, SD=1
11	LC = 6, UC = 1	LC = 2	LC = 17, UC = 8	LC = 4, UC = 2	LC = 14, UC = 10	LC=1, UC=11	LC=5
Total	LC = 39, UC = 159, SD = 4	LC = 48, UC = 190, SD = 2	LC = 53, UC = 248, SD = 6	LC = 54, UC = 165, SD = 4	LC = 36, UC = 311, SD = 11	LC=16, UC=184, SD=4	LC=78, UC=129, SD=9

Fish trapped: LC = least chub, UC = Utah chub, SD = speckled dace

† Largemouth bass observed

‡ Largemouth bass and goldfish observed

* = Area de-watered due to diversion of Foote Reservoir

Table 3. Number and percentage of springs where least chub were captured at Gandy Marsh and Bishop Springs from 1993 to 2005.

Year	Gandy	Bishop Springs	Total
1993	22 of 50 (44.0%)	11 of 13 (84.6%)	33 of 63 (52.4%)
1994	18 of 50 (36.0%)	07 of 13 (53.8%)	25 of 63 (39.7%)
1995	15 of 50 (30.0%)	05 of 11 (45.5%)	20 of 61 (32.8%)
1996	15 of 50 (30.0%)	08 of 13 (61.5%)	23 of 63 (36.5%)
1997	13 of 50 (26.0%)	05 of 13 (38.5%)	18 of 63 (28.6%)
1998	15 of 51 (29.4%)	09 of 13 (69.2%)	24 of 64 (37.5%)
1999	15 of 51 (29.4%)	07 of 13 (53.9%)	22 of 64 (34.4%)
2000	15 of 52 (28.9%)	08 of 13 (61.5%)	23 of 65 (35.4%)
2001	11 of 52 (21.2%)	08 of 13 (61.5%)	19 of 65 (29.2%)
2002	11 of 52 (21.2%)	09 of 13 (69.2%)	20 of 65 (30.8%)
2003	08 of 52 (15.4%)	05 of 13 (38.5%)	13 of 65 (20.0%)
2004	09 of 52 (17.3%)	07 of 13 (53.8%)	16 of 65 (24.6%)
2005	12 of 52 (23.1%)	10 of 13 (76.9%)	22 of 65 (33.8%)

Table 4. Number and percentage of springs where Utah chub were captured at Gandy Marsh and Bishop Springs from 1993 to 2005.

Year	Gandy	Bishop Springs	Total
1993	07 of 50 (14.0%)	10 of 13 (76.9%)	17 of 63 (27.0%)
1994	08 of 50 (16.0%)	08 of 13 (61.5%)	16 of 63 (25.4%)
1995	14 of 50 (28.0%)	09 of 11 (81.8%)	23 of 61 (37.7%)
1996	10 of 50 (20.0%)	09 of 13 (69.2%)	19 of 63 (30.2%)
1997	05 of 50 (10.0%)	06 of 13 (46.2%)	11 of 63 (17.5%)
1998	09 of 51 (17.7%)	09 of 13 (69.2%)	18 of 64 (28.1%)
1999	04 of 51 (07.8%)	07 of 13 (53.9%)	11 of 64 (17.2%)
2000	04 of 52 (07.7%)	09 of 13 (69.2%)	13 of 65 (20.0%)
2001	04 of 52 (07.7%)	10 of 13 (76.9%)	14 of 65 (21.5%)
2002	04 of 52 (07.7%)	12 of 13 (92.3%)	16 of 65 (24.6%)
2003	03 of 52 (05.8%)	08 of 13 (61.5%)	11 of 65 (16.9%)
2004	03 of 52 (05.8%)	11 of 13 (84.6%)	14 of 65 (21.5%)
2005	04 of 52 (07.7%)	09 of 13 (69.2%)	13 of 65 (20.0%)

Table 5. Number and percentage of springs where speckled dace were captured at Gandy Marsh and Bishop Springs from 1993 to 2005.

Year	Gandy	Bishop Springs	Total
1993	27 of 50 (54.0%)	05 of 13 (38.5%)	32 of 63 (50.8%)
1994	13 of 50 (26.0%)	02 of 13 (15.4%)	15 of 63 (23.8%)
1995	15 of 50 (30.0%)	03 of 11 (27.3%)	18 of 61 (29.5%)
1996	21 of 50 (42.0%)	00 of 13 (00.0%)	21 of 63 (33.3%)
1997	14 of 50 (28.0%)	00 of 13 (00.0%)	14 of 63 (22.2%)
1998	07 of 51 (13.7%)	02 of 13 (15.4%)	09 of 64 (14.1%)
1999	03 of 51 (05.9%)	02 of 13 (15.4%)	05 of 64 (07.8%)
2000	10 of 52 (19.2%)	02 of 13 (15.4%)	12 of 65 (18.5%)
2001	07 of 52 (13.5%)	04 of 13 (30.8%)	11 of 65 (16.9%)
2002	10 of 52 (19.2%)	02 of 13 (15.4%)	12 of 65 (18.5%)
2003	05 of 52 (09.6%)	03 of 13 (23.1%)	08 of 65 (12.3%)
2004	11 of 52 (21.2%)	02 of 13 (15.4%)	13 of 65 (20.0%)
2005	08 of 52 (15.5%)	06 of 13 (46.2%)	14 of 65 (21.5%)

Table 6. Fish species captured at Gandy Marsh complex, Snake Valley, Utah from 1993 to 2005.

Spring	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	-	-	-	-	-	-	-	-	-	-	*	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	*	-	-
4	SD	-	-	-	-	SD	SD	-	-	-	-	-	-
5	SD	LC	-	LC, SD	-	-	LC	LC, SD	LC, SD	LC, SD	-	SD	UC
6	LC	LC	LC	LC, SD	SD	LC	LC	LC, SD	-	LC, SD	-	-	-
7	-	*	*	*	*	*	*	*	*	*	-	-	-
8	LC, SD	LC	LC, SD	LC	LC	LC	LC	LC	LC, SD	LC, SD	LC, SD	LC, SD	LC
9	-	SD	-	LC, UC, SD	LC	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-
11	LC, SD	UC	-	-	-	-	-	-	-	*	-	-	-
12	LC, SD	LC	LC	LC	-	LC, UC	-	LC	-	*	*	-	-
13	-	-	-	-	SD	-	-	-	-	-	-	-	-
14	LC, SD	LC, SD	LC, UC, SD	LC, UC, SD	LC, SD	LC	LC, UC	LC, UC	LC, UC	LC, SD	-	SD	-
15	LC, SD	-	-	-	*	*	LC	-	*	*	-	-	-
16	LC, UC	LC, UC	UC	UC, SD	UC, SD	UC	LC, UC	LC	LC, UC	-	LC, UC	LC, UC, SD	LC, UC, SD
17	LC, UC	LC, UC, SD	LC, UC, SD	LC, UC, SD	LC, UC, SD	LC	LC	LC	LC, UC, SD	LC, UC, SD	LC, UC, SD	LC, UC, SD	LC, SD
18	-	-	-	-	-	-	-	*	-	*	-	-	LC
19	-	-	-	-	-	-	-	-	-	*	-	-	-
20	SD	SD	UC	UC	-	LC, UC	LC	LC, UC	LC	LC, UC	LC, UC	-	LC, UC
21	-	-	-	-	-	-	-	-	-	-	-	-	-
22	SD	-	UC	-	-	-	-	-	-	*	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-
24	LC	-	UC	SD	-	-	-	-	-	*	-	-	*

Table 6. (continued)

Spring	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
25	-	-	*	*	*	-	*	-	*	*	-	-	*
26	LC, SD	UC	LC, UC	-	UC	UC	LC, UC, SD	SD	UC	UC	-	-	-
27	SD	-	-	SD	-	-	-	-	-	-	-	-	*
28	LC	LC	UC	LC, SD	LC	LC, SD	LC	LC, SD	LC, SD	LC, SD	LC, UC	LC,SD	LC, SD
29-37	LC, SD	-	LC, SD	LC, SD	LC, SD	LC, SD	LC	LC, SD	-	SD	-	SD	-
38	LC, SD	LC, SD	LC, SD	LC	LC	LC	LC	LC	LC, SD	LC, SD	LC, SD	LC	LC
39	LC, SD	LC, SD	UC, SD	SD	LC, SD	LC, SD	SD	LC, SD	LC, SD	LC, SD	-	LC, UC	LC, SD
40	SD	-	SD	SD	LC, SD	-	-	SD	SD	-	SD	-	SD
41	-	-	-	-	-	-	-	-	-	-	-	-	-
42	LC, UC, SD	LC	LC, UC, SD	SD	-	-	-	-	-	-	LC	LC	-
43	LC, SD	LC, UC, SD	LC, SD	LC, SD	-	-	-	-	-	-	-	-	-
44	LC, UC, SD	LC, UC	LC, UC, SD	LC, UC, SD	LC	LC, UC	LC, UC	LC	LC	LC, UC	-	LC, UC, SD	LC, SD
45	LC, UC, SD	LC, UC, SD	SD	LC, UC, SD	-	LC, UC	-	SD	-	-	-	-	SD
46	LC, SD	LC, SD	LC, UC, SD	LC, UC, SD	LC, UC	LC	LC	LC	LC	-	-	-	SD
47	SD	SD	SD	-	-	-	-	-	-	-	-	SD	-
48	SD	-	SD	-	SD	-	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-	-	-	-	-	-	-
50	-	-	-	-	*	*	-	*	*	*	*	-	*
51	-	-	-	-	-	LC, UC	-	-	-	-	-	-	-
52	-	-	-	SD	SD	-	-	*	-	-	-	-	LC
53	LC, SD	-	-	SD	LC, SD	LC, SD	-	LC, SD	*	LC, SD	LC	LC, SD	SD
54	-	LC, SD	-	UC	-	UC, SD	-	UC, SD	-	-	-	-	-
55	UC, SD	LC, UC, SD	LC, UC	LC, UC	UC, SD	UC	-	UC	-	-	-	-	LC

Table 6. (continued)

Spring	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
56	LC, SD	LC, SD	LC, SD	SD	LC, SD	SD	-	-	-	-	-	-	-
57	LC, UC, SD	-	LC	SD	LC	-	LC	*	*	*	-	-	LC
58	SD	-	-	-	SD	-	-	-	-	-	-	-	-
59	#	#	#	#	#	#	#	-	-	-	-	-	-
60	#	#	#	#	#	-	-	-	-	-	-	-	-

Fish trapped: LC = least chub, UC = Utah chub, SD = speckled dace

* = Contained < 5cm of Water

= Site Not Sampled

Table 7. Fish species captured at Bishop Springs, Snake Valley, Utah from 1993 to 2005.

Spring	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
S Twin	LC, UC	UC, ‡	UC, ‡	UC, ‡	UC, ‡	‡	-	‡	UC	UC, †	LC, UC, †	UC	LC, UC, SD
N Twin	UC, †	UC	UC	UC, †	UC, †	UC	-	UC	UC	UC	UC	LC, UC	-
1	LC	*	Not Sampled	LC, UC	*	*	*	*	-	LC, UC, SD	*	LC, UC	LC, UC
2	LC, SD	-	Not Sampled	LC	*	*	*	*	LC, UC	LC, UC	*	-	LC
3	LC, UC	LC	*	LC, UC	*	LC, UC, SD	LC	LC, UC	LC, UC	LC, UC	*	LC, UC	LC, UC
4	LC, UC	LC, UC, SD	*	LC, UC	*	LC, UC, LB	-	LC, UC	LC, UC	LC, UC	*	LC, UC	LC, UC, SD
5	LC, UC, SD	LC, UC	LC, UC, SD	LC, UC	*	LC, UC, SD	LC, UC, SD	LC, UC,	UC	LC, UC	*	UC	UC, SD
6	LC, UC	LC	LC, UC, SD	-	LC	LC	LC	LC, UC	LC, UC, SD	LC, UC, SD	LC, UC, SD	UC	LC
7	LC, UC, SD	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC, SD	LC, UC, †	LC, UC	LC, UC	LC, UC
8	UC, SD	LC	LC, UC, SD	LC, UC	LC, UC	LC, UC	LC, UC	LC, UC, SD	LC, UC, SD	LC, UC	UC, SD	LC, UC	LC, UC, SD
9	LC, UC	UC	UC	UC	LC, UC	LC, UC	LC, UC	LC, UC	UC, SD	-	LC, UC	UC	LC, UC, SD
10	LC, UC, SD	LC, UC	UC	-	UC	LC, UC	UC, SD	UC	LC, UC	UC	UC, SD	SD	UC, SD
11	LC	UC, SD	LC, UC	LC	LC	LC, UC	LC, UC	LC	LC, UC	LC, UC	LC, UC	LC, UC	LC

Fish trapped: LC = least chub, UC = Utah chub, SD = speckled dace, LB = largemouth bass

† Largemouth bass observed

‡ Largemouth bass and goldfish observed

* Area de-watered due to diversion of Foote Reservoir.

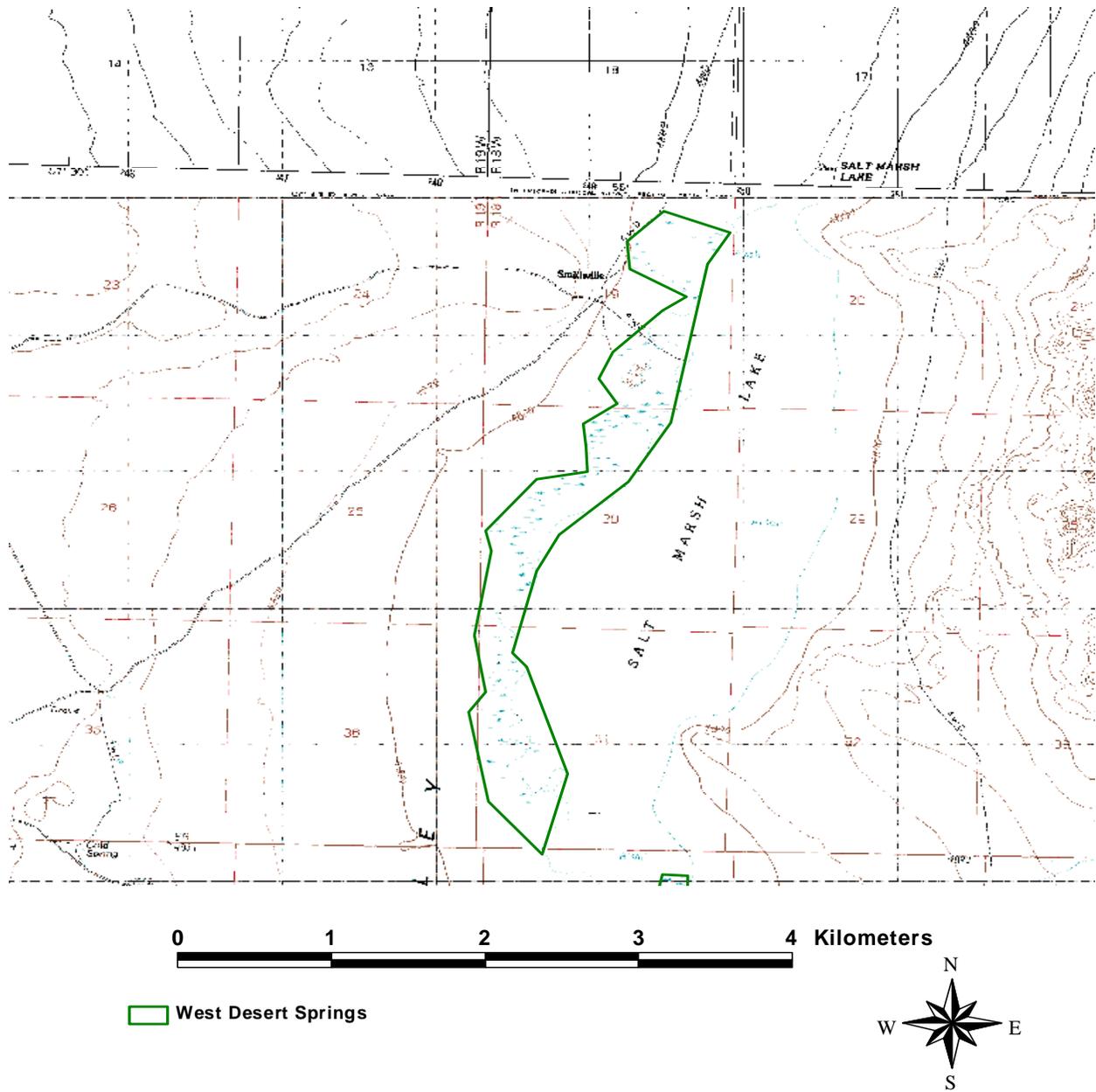


Figure 1. Location of Gandy Marsh least chub monitoring site (Gandy quadrangle, 7.5 minute series, 1:25,000 scale, Millard County UT).

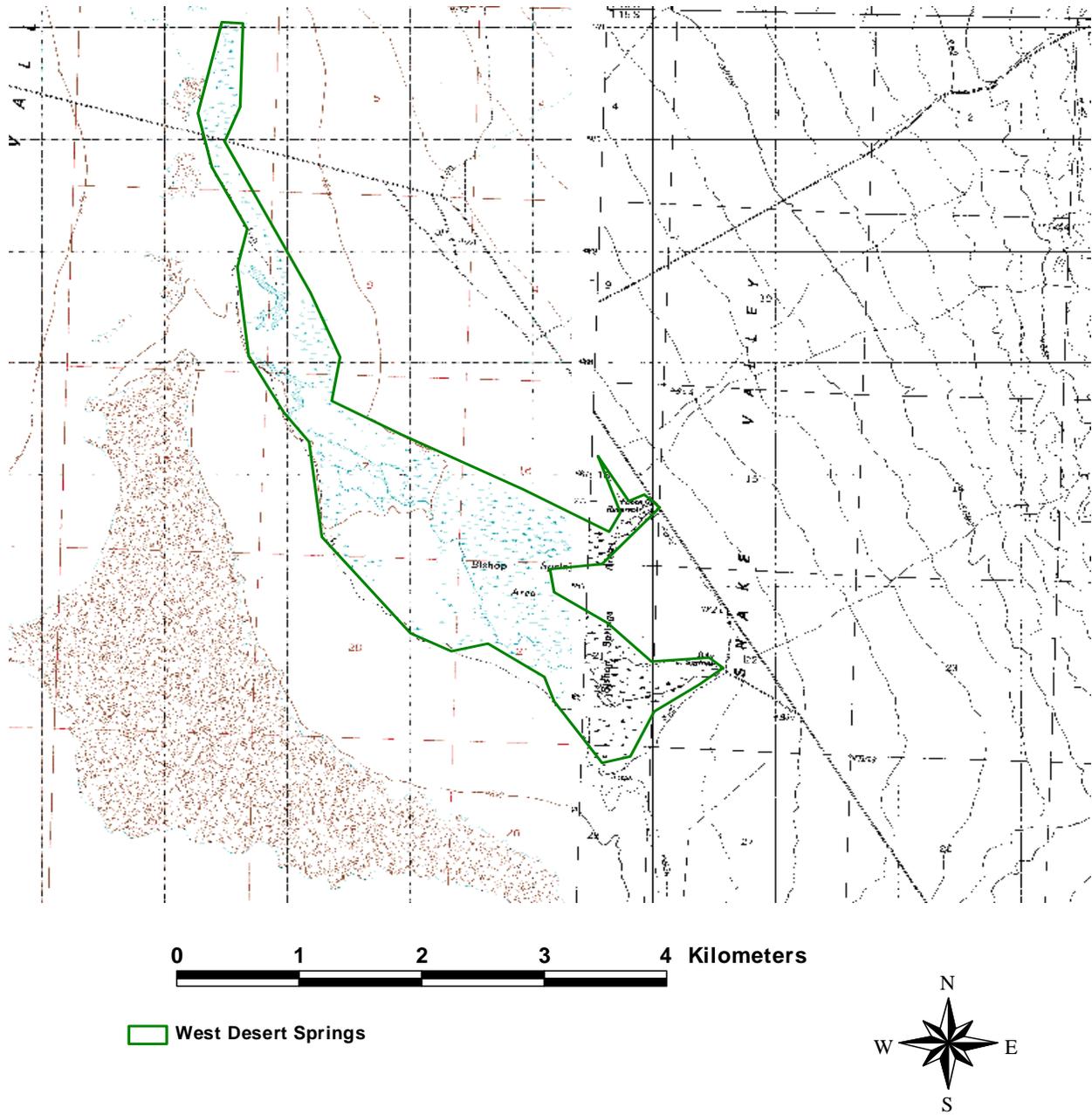


Figure 2. Location of Bishop Springs least chub monitoring site (Gandy quadrangle, 7.5 minute series, 1:25,000 scale, Millard County, UT).

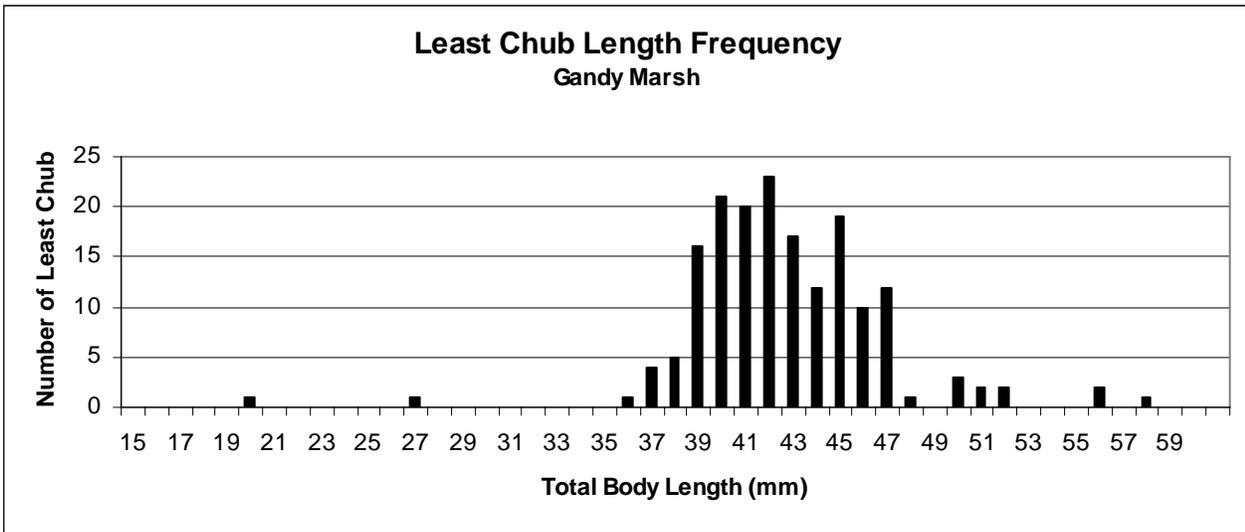


Figure 3. Length frequency distribution of least chub (n = 173) captured at Gandy Marsh complex monitoring sites, Snake Valley, Utah, August 2005.

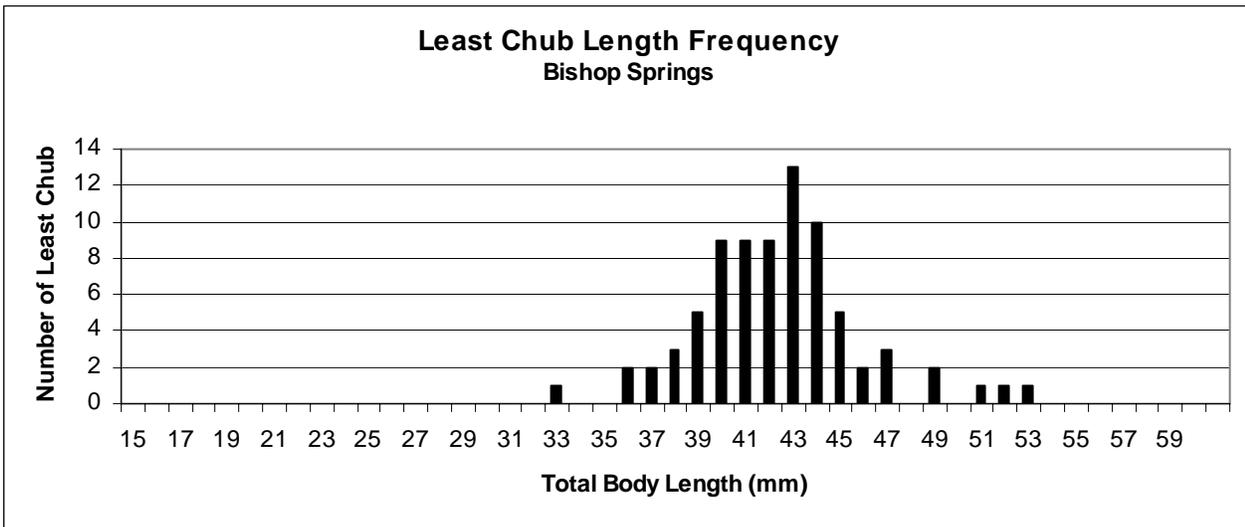


Figure 4. Length frequency distribution of least chub (n = 78) captured at Bishop Springs monitoring sites, Snake Valley, Utah, August 2005.

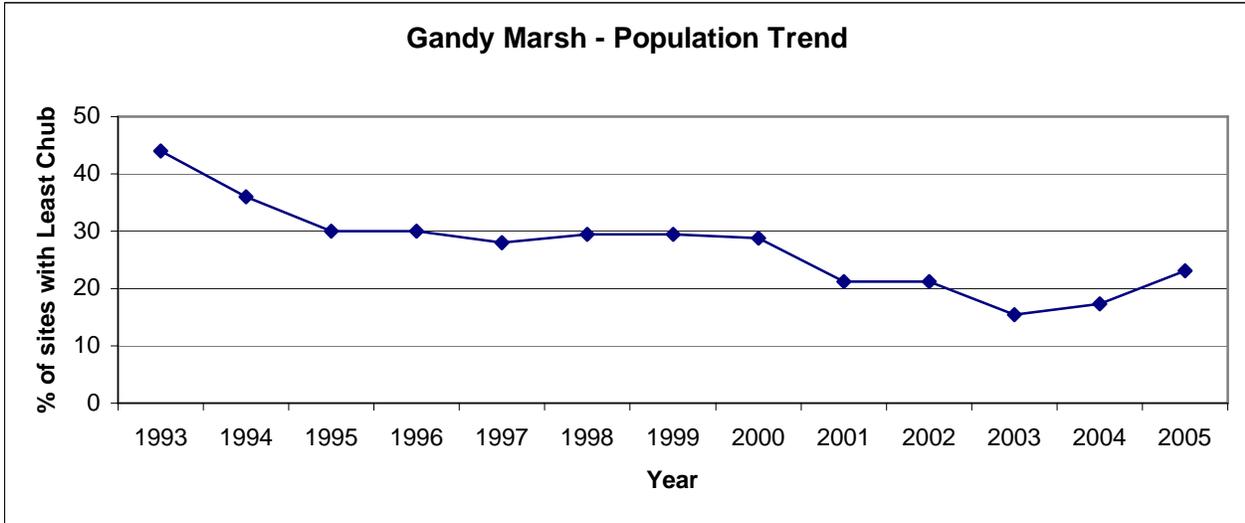


Figure 5. Percentage of sampling sites containing least chub during annual monitoring at Gandy Marsh, Snake Valley, Utah, from 1993 to 2005.

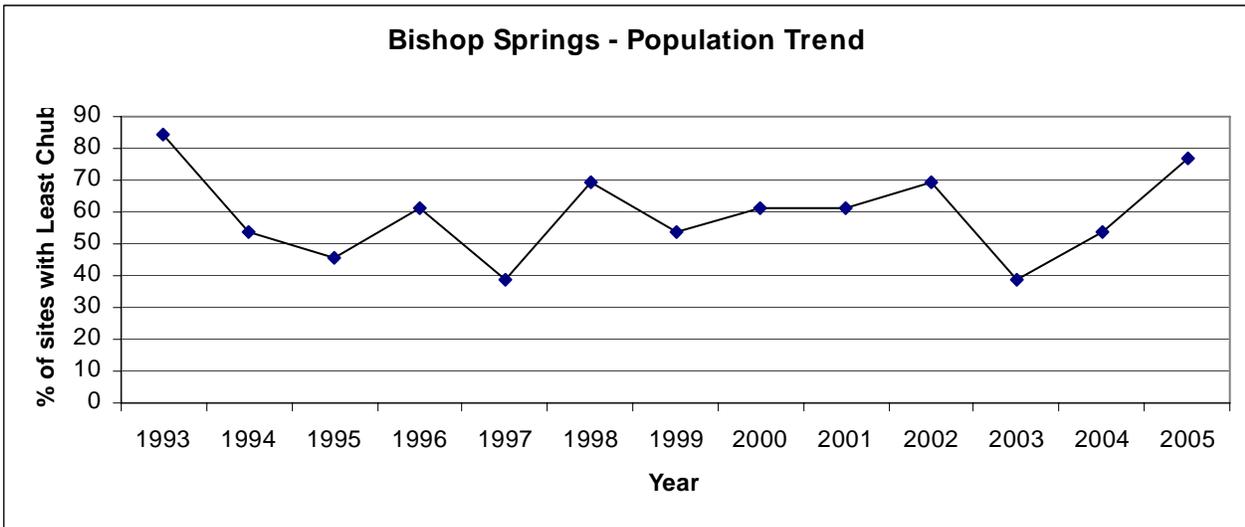


Figure 6. Percentage of sampling sites containing least chub during annual monitoring at Bishop Springs, Snake Valley, Utah, from 1993 to 2005.

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